SCIENCE

VOL. 93 FRIDAY, JANUARY 3, 1941 No. 2401

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

THE BODY PHYSIOLOGIC AND THE BODY POLITIC[1]

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AT this bewildering time, when ancient customs are not respected, when new forms of society are being advocated and tried, when doubts cloud plans for present and future action, it is pertinent to inquire whether we might seek and find a social organization which would yield more of the benefits of security than we now enjoy. This search is natural. In the evolution and behavior of living beings the trend towards security has been one of the outstanding features. The oyster's shell, the bird's quick wings, the tiger's teeth and such human devices as clothing, houses and the varieties of insurance illustrate the universality of provisions for assured existence. The search for security is also important. In the relations among men in civilized nations there are many harrowing uncertainties. Industries are destroyed by inventions; business catastrophies create misery as hosts of laborers are suddenly thrown out of employment or realize that they hold precarious jobs; wars inflict on great populations death or painful and debilitating wounds and spread far and wide wretchedness and want. Under such stressful conditions masses of men may be led into precipitate and violent action. No wonder, then, that we look for a more stable society. Yet there are values we would not lose in the effort to gain greater stability of social organization. We would by all means wish to avoid the blight of a fixed rigidity of occupations or classes. We would wish also to avoid any check on human ingenuity directed towards advancing the welfare of mankind. Those

[1] Address of the retiring president of the American Association for the Advancement of Science, Philadelphia, December 27, 1940. This essay is an elaboration of ideas expressed in an epilogue to a volume published in 1932, entitled "The Wisdom of the Body."

consequences would be blighting. Freedom must be preserved—for fresh discoveries and contrivances, for novel enterprise and for the emergence of eminent ability whatever its origin. A social order assuring not security alone, not freedom alone, but both security and freedom, is the desirable goal.

If we examine any social or industrial group we note that it presents two sorts of relations, internal and external. The family, for example, must have regard for the intimate accommodations among its members in the home; and it must encounter in its environment the school, the regulations of local government and other conditioning agencies. Industry, likewise, must arrange for adjustments within and without; inside the walls of its plant it must consider the numbers and activities of its employees, their superintendence and their pay; and outside it must be on the alert for altered demands for its manufactured goods, for maneuvers of its competitors, for shifts in the community, for changes of style and for governmental requirements. Even among nations inward and outward concerns are distinguished routinely; some officials are assigned to meet the problems and to administer the country's interior affairs, other officials are assigned to study its relations with other powers, *i.e.*, to attend to foreign affairs.

Observe that states of stability and instability in the nation, in industries and in homes are closely linked. When a break occurs in the even course of activities of larger aggregations, having widespread influence, the harmful consequences are likely to reach down to the ultimate units in the social structure, human beings. They, who are least influential in the very complicated social and economic hierarchy of influences, are the almost helpless victims. Recognition of that fact is the stimulus for the efforts to devise an organization of society which will furnish a greater assurance than hitherto that mankind shall not suffer distress and privations which are of human origin and which might be avoided by applying human intelligence.

For purposes of later discussion it is pertinent to note at this point that in the functional organization of our bodies there are relations and activities which can be distinguished as external and internal. Our *external* activities are directed towards modifying our surroundings or changing our position with regard to them—manufacturing merchandise, or engaging in hard play, or working for food and shelter—indeed, they include all the voluntary uses of our muscles. Such outwardly directed actions, however, have effects within; they use up our stores of energy-yielding material, they produce acid which might clog the working parts, they increase the amount of waste which must be discharged. These alterations, unless corrected, are capable of interfering to a serious degree with the efficiency of our bodily performance. It is the function of the *internal* activities of the organism to prevent or correct these alterations and maintain stability; thus our bodies are held in a fit state for continued action, or are made ready for special efforts when critical situations arise. Furthermore, the internal activities preserve a fitness for work despite variations in the outer world, such as excessive heat or cold, that might be deeply disturbing. The remarkable effectiveness of the regulative processes of the body's department of the interior in preserving fitness is one of the marvels of biology.

Wonderment over the maintenance of steady states in the human organism increases when we consider that we are composed of substances that are in the highest degree unstable and are commonly responsive to extremely slight modifying influences. The retina, for example, is many hundreds of times more sensitive than the most sensitive photographic plate, and brain cells are instantly dependent on a continuous supply of oxygen-bearing blood. A persistent stability of these supremely labile parts appears all the more astounding when we recognize that the organism is an open system, receiving periodically from the outer world material for its repair and for the doing of work, and giving forth continuously the products of its own decomposition. We should observe, furthermore, that this stability is manifest not only in adulthood but also in the early decades when the body is undergoing a manifold increase of size, and that it is steadfast at all stages of life, although powerful alterative forces may be operating from both within and without. Here is an outstanding achievement, the result of evolutionary processes during immeasurable eons of past time. We are warranted in examining this supreme triumph of organization by nature for possible light on present defects of organization by man.

The most important device which enables our bodies to preserve steady states, notwithstanding conditions which might hamper or be destructive, is the constant character of the circulating fluids of the organism, especially the circulating blood. Our living parts are bathed by these fluids. We exist, therefore, not in the air which surrounds us—we are separated from that by a layer of inert material. We exist in a fluid matrix which provides us each with a private internal environment. Just in so far as this internal environment or fluid matrix is kept from noteworthy variations, there are no internal adjustments to be made; the internal organs can perform their functions undisturbed by the ups and downs of external circumstance or by possible consequences of our own strenuous activity.

A few examples will make these statements clearer. There is, first, the steadiness of our body temperature,

a trait we share with most other mammals and with birds. Though these forms may be exposed to wide variations of temperature without they preserve an equable degree of heat within. The development of a nearly thermostable state in higher vertebrates should be regarded as one of the most valuable advances in biological evolution. Animals which maintain an approximate uniformity of temperature are released from the limitations which might be imposed by seasonal changes; they are not forced to escape either from the torpor of winter's frost or the stroke of summer's torrid heat. Again, there is the steadiness of the mild alkalinity of the blood. A slight shift to an acid reaction would result promptly in coma and death; a slight shift to a more alkaline reaction would bring on convulsions. We avoid both these dangerous possibilities because of arrangements which preserve a striking constancy of the acid-alkali relations of the internal environment. Another example of steadiness is seen in the sugar concentration of the blood. If the concentration rises to a moderate degree the sugar is wasted by spilling through the kidneys; if the concentration falls to a low level convulsions and coma ensue. These hazards might arise in prolonged and vigorous exercise. Then much heat is set free by the contracting muscles, also a large amount of acid is discharged from them, and blood sugar is abundantly utilized. In spite of the possibility of serious consequences—coma, convulsions and thermal damage—they rarely occur. Regulatory processes slip into action and preserve in the fluid matrix a relatively constant state. So characteristic is this constancy, and so peculiar are the processes which maintain it, that it has been given a special name, *homeostasis*.

Homeostasis is accomplished by different means according as processes or materials are involved. For instance, a process of discharging heat from our bodies is always going on at a moderate pace. If the bodily temperature tends to fall the discharge of heat is checked and at the same time there is greater heat production; if the temperature tends to rise the discharge is accelerated. Thus by varying the rate of a continuous process a relatively stable thermal condition is maintained. Similarly, in preserving the mild alkalinity of the blood, governing agencies are nicely adjusted. If a slight amount of acid begins to accumulate, as happens in exercise, breathing becomes more rapid, the heart beats more frequently, the circulation is hastened, more oxygen is delivered to the active organs to burn non-volatile acid, and simultaneously the faster processes rid the body of the resultant excess of volatile carbonic acid. Again homeostasis is preserved.

In so far as materials are concerned steady states are assured by storage in times of plenty and release from storage in times of need. We take in provisions occasionally, we are using them constantly. When food is plentiful, for example, starchy reserves are stored in the liver. If now the sugar in the blood becomes reduced, these hepatic reserves are drawn upon and thereby a safe concentration in the blood is maintained. Excessive increase of material in the blood is avoided by overflow. Too much salt, too much water or too much sugar, taken at one time, are not allowed to accumulate and alter the relative constancy of the internal environment. The kidneys, acting as a spillway, permit the surplus to flow out of the body.

In relation to the maintenance of homeostasis three points may be emphasized. First, it is noteworthy that a special portion of the nervous system has become established that coordinates, in an automatic manner, the variable processes and the material reserves which are involved in keeping a comparatively uniform consistency of the blood. Second, this nervous organization is mainly for emergency use. Experiments have demonstrated that there can be, to a considerable extent, local autonomy in the functioning of the cooperative parts. The liver, for example, can by itself store and release its carbohydrate reserves; the island cells of the pancreas can act independently to manage the use of sugar in the organism; and the heart can perform its functions as a pump quite isolated from nervous government. Third, when stability is threatened, even to an apparently mild degree, extremely sensitive indicators are affected which promptly bring into operation the proper corrective agencies. Thus the oscillations on either side of a homeostatic norm are slight. Indeed, the responsible organs of the body react to any disturbing condition as if they were directed towards preserving a steady state in the internal environment.

Besides the regulatory arrangements which work for stability we should recognize the significant fact that our bodily organization is set up, as a rule, with a large margin of safety. Except in parts of the brain we are not built on a scant and skimpy plan. For example, we have two kidneys, we need only one; we carry much longer intestines than are actually required; half of the lung area, half of the thyroid gland, more than half of the pancreas can be removed without markedly altering the uniform state of the fluid matrix. When we consider the possible damage to organs by accident or disease this liberal mode of construction is obviously important for the persistence of the organism.

Another arrangement making for stability is, interestingly enough, characterized by temporary alteration of the fluid matrix. That is manifest when bodily welfare is imperiled by enemies. If there is a bacterial attack the number of protective corpuscles in the blood is augmented, or an antitoxin is developed to counteract a circulating toxic substance, and the body tem-

perature rises in fever as part of the defense. If larger foes appear, requiring flight or combat, fear or rage is aroused, emotional reactions which are attended by a remarkable and commonly the greatest possible mobilization of the bodily forces for physical struggle. Even though fierce muscular conflicts between man and man or between man and beast are rare in civilized countries, the internal adjustments appropriate for victory are fully retained in us and are ready for instant response. The body is unified, integrated, for a single purpose—survival. Blood sugar is increased, the heart beat is accelerated, blood is specially distributed to the active regions and is circulated at a faster pace, respiration is deeper and more frequent, extra corpuscles are set moving to carry more oxygen, and adrenaline is discharged to reinforce the adaptive nerve impulses. Of course, all these reactions profoundly disturb the internal environment; they disturb it, however, to render the organism more effective in a contest which may issue in either life or death.

In violent struggle non-volatile acid waste is produced in muscles more rapidly than available oxygen can burn it. The accumulation of unburned acid may in the end greatly lessen muscular efficiency, but when there is an emergency that risk is run. It is obvious, however, that when the emergency has passed, extra oxygen must be delivered to remove the liability created by the waste, *i.e.*, an "oxygen debt" has been created. That debt is not deferred by the body; it is promptly paid by persistent deep breathing and rapid blood flow to provide an oxygen delivery of the requisite amount. Thus a condition which might seriously limit freedom of action is soon abolished. Whether foes be small or large, therefore, an admirable readiness and ability to assemble protective forces are disclosed. And after danger has vanished normal homeostasis is quickly restored.

A final notable feature of bodily organization is the special favoring of certain organs when internal conditions take an unfavorable turn. Of these the brain and the heart are the two most privileged. Both are specially dependent on a continuous supply of oxygen; the brain because it contains nerve cells which are exquisitely sensitive to oxygen lack, and the heart because it requires oxygen for its ceaseless pulsing. In a condition which reduces the oxygen delivery, as after a severe hemorrhage, these two organs are soon receiving a normal blood flow, but at the expense of other parts. In starvation also, heart and brain are spared while other structures are slowly consumed.

Mention of the favored treatment of the brain makes pertinent at this point an interpretation of the significance of physiological homeostasis. It is a condition which in the course of organic evolution has been only slowly acquired. Among lower vertebrates, for example, most amphibians are bound to a nearby water source lest they desiccate. And during the long winter they must lie sluggishly at the bottom of an icy pool. Reptiles, having developed a dry skin, may move freely over the land without danger of a disastrous water loss, but they too are rendered inert for months by seasonal cold. When higher vertebrates, during stupendous ages of evolution, acquired a constant temperature and other constancies of the internal environment, when the functions of the body were more and more liberated from disturbing or limiting conditions, what is the advantage that was gained? The answer to that question is that homeostasis has released for the exercise of their peculiar services the higher functions of the brain. If we had to attend momentarily to preserving a proper alkaline reaction in the blood, or preventing its sugar concentration from falling dangerously low, or checking harmful variations of body temperature, we should have time for little else. In the myriads of millennia during which vertebrates were evolving, these functions developed and became automatically controlled. And to the degree that the control was perfected, man, in his complex external environment, has attained freedom of action. Thus our bodies disclose a type of organization in which both stability and liberty have been achieved.

We have previously noted that there are other organizations—domestic, industrial, governmental—which, like the human organism, face problems of internal and external adjustments. Their external adjustments relate to circumstances which may profoundly affect many included units or groups. In a similar situation, as we have just seen, our bodies, by the evolution of a self-regulated internal economy, have become to a high degree liberated from deranging external influences. Can this sort of liberty be achieved in human society? Historical evidence clearly reveals that human society has been undergoing an evolutionary development; and observation indicates that even in civilized nations it is still in an early stage of that development. Wherever complicated functions are performed there appear to be general principles of organization which are more or less realized. It may be that our bodies, which are the culmination of ages of experience, have learned secrets of management that are worthy of our study. We must admit that organisms have long shown abilities beyond the present reach of human ingenuity—for example, the compounding of elaborate chemicals (proteins, fats, carbohydrates), the contrivance of self-reproduction, the nice control of a gradual increase in size of a manifold structure. Only within our memory has man learned to fly as birds have flown for millions

of years. Indeed, the manner in which our bodies have found both stability and liberty may have lessons for larger and less perfect organizations.

The resemblance between the body biologic and the body politic has long attracted the interest of philosophers, biologists and historians. Among sociologists, economists and men of affairs, however, the analogies have been largely discredited, because, it is said, the comparisons have not contributed to the understanding of social structure. The failure to be helpful seems to have been due to pressing to an absurd degree resemblances in the minutiae of that structure. We are not illuminated by a likening of manual laborers to muscle cells, manufacturers to gland cells, bankers to fat cells and policemen to white blood corpuscles. On the other hand, analogies may be instructive if, instead of a comparison of structural details, there is inquiry into relative functional accomplishments in the physiological and social realms. Naturally, on undertaking this inquiry a physiologist must proceed not as an expert in the social realm but as a layman. In the realm of physiological organization, he finds that, despite inherent structural instability and despite constant exposure of unstable organic stuff to powerful destructive forces, an almost incredible steadiness has been achieved. Are not the principles exemplified in the workings of our bodies sufficiently fundamental to have social applications? Might not the outstanding achievement of bodily homeostasis, the means of which have been revealed by fairly recent discoveries, be indicative of ends to be sought, and the means of attaining them, in social evolution? An attempt to answer these questions may not present to students of society any new ideas; the success of the physiological organism, however, may add emphasis to some ideas which are already well recognized. With this admission of hazard in the venture, standing as a boundary post between observed facts and possible pertinencies, a comparison of the body politic and the body physiologic is undertaken.

What corresponds in a nation to the internal environment of the body? The closest analogue appears to be the whole intricate system of production and distribution of merchandise. It would include the means of industry and commerce—the agencies of manufacture and agriculture, the rivers, the roads and railroads, trains and trucks, wholesale and retail purveyors—all the factors, human and mechanical, which produce and distribute goods in the vast and ramifying circulatory system which serves for economic exchange. Into this moving stream products of farms and factories, of mines and forests, are placed, at their source, for carriage to other localities. In the operations of this stream one is allowed to take goods out of it only if one puts back into it goods of equivalent worth. As a rule it is not possible to do that immediately, or to furnish the full replacement value exactly when goods are removed. Money, therefore, is used to facilitate the process of exchange, or credit may serve as a temporary substitute. Thus money and credit become a part of the internal environment of society.

The bodily analogue has been regarded by some as indicating that just as there is fixity of the units (*i.e.*, the cells) in the internal organs, there must be fixity of the human units in the diverse parts of the social structure. That condition, however, is not essential. Emphatically, the essential condition is *functional*—a continuity of service. Men are needed, of course, to operate farms, factories and railroads, but so long as these services are maintained, men may move freely from one position to another. As we shall see later, society, unlike man, is not limited by death; society lives on, for indefinite time, precisely because the human units are replaceable. In social organizations, therefore, the closest analogues to the parts of the body are not the ultimate units, the human beings; the closest analogues are the functional groups—the special trades and professions and the various labor types. They correspond to the bodily organs.

On the assumption that industry and commerce constitute the internal environment of society what has the experience of the biological organism to suggest as a result of its own attainment of stable states?

It suggests, first, that the primary condition for freedom from the operation of disturbing forces, both within and without, is a maintained constancy of the internal environment. According to that required preliminary the moving commercial stream should deliver continuously, to units which are recognized as serving society, at least the necessities of existence—food, shelter and protection and assured assistance if there be injury or disease. Constancy would involve also reliable opportunity for every man to have uninterrupted work and the payment of a wage or other recompense sufficient to permit him to obtain from the stream what he and his dependents actually require. Only in recent years have some of these practices begun to be respected. Others are only discussed. In these regards the body biologic has developed further and become more effective than the body politic in its organization for internal homeostasis.

A second suggestion which physiological organization offers is that trends towards dangerous shifts of stability should be noticed at the start and controlled immediately. We have seen that any even minor tendency towards such a shift in the bodily organism is quickly detected by delicate indicators, and corrective processes are at once evoked to prevent further change

and to restore the former state. In society these regulatory devices are little known or are lacking altogether. We do note that a crude sort of oscillation occurs: loose government is followed by reform and that in turn by loose government again; a boom ends in a depression, and after recovery there is another boom. These swings of social mood by their cumulative effects can cause intense distress. Deeper insight into what starts them, what stops them and how they can be avoided is highly desirable. Furthermore, in the body politic an initial disturbance, instead of promptly arousing protective and corrective factors, often starts a harmful process which spreads through a community with accelerating speed. Thus, when a run on a bank begins, it is self-intensifying. As the claims of depositors force a closure, fears are aroused, and the run extends to other banks, until a national moratorium may be required to permit recovery. Still another example of self-aggravating damage to social stability is seen when stock prices decline; margin calls which are sent out provoke a further fall of the prices and the sending out of further calls; an unchecked circuit of injurious behavior ensues, ending in panic. In short, when danger threatens, stabilizing agencies do not act on the instant to guarantee security; instead, disruptive factors have full sway. The situation demands research on economic fluctuations and on modes of governing them, for the human organism has demonstrated that in an extremely unstable structure there are ways of maintaining steadiness. It is of interest to note that efforts have been made to find sensitive signals of perilous economic tendencies and to set in motion corrective measures. Thus, an index of velocity of deposits was intended as a warning of excessive business activity; and theoretically the condition might be remedied by raising the discount rate. Control of this remedy, however, is subject to influences playing on human prejudice, and its operation will probably remain imperfect until greater knowledge and experience permit more precise decisions.

A further hint offered by bodily homeostasis is that industries and commerce should be organized to operate smoothly in caring not only for routine but also for emergency conditions. In the organism storage of excess material when it is plentiful and release from storage as want arises provide for variable supplies and variable demands without altering the uniformity of the internal environment. The prime value of these methods has recently been recognized by both government and industry. Within the last few years the establishment of agricultural and commodity credit policies, which allow the withholding of surpluses in fat periods, for sale in lean periods, illustrate governmental recognition of the importance of uniform distribution for both producers and consumers. Also commercial storage by preserving perishable foods, by permanent sterilization or by freezing, has been much developed of late, with the result that former seasonal glut or dearth in the markets has become almost obsolete.

In the organism smooth operation under variable demands is achieved also by changing the rate of continuous processes. Those processes are characteristically conducted at a moderate pace, an arrangement which permits them to be varied, *i.e.*, slowed down or speeded up according to requirements. In the body politic the control of processes still has far to go. Instead of a change of rate a frequent alternative is a total stoppage of the process; men are thrown out of their jobs and drift in idleness. How industry and commerce can be adjusted to inconstant or temporal demands has not yet been discovered. Various schemes for coordinating production and consumption and for assuring regularity and continuity of employment prove that thoughtful men are deeply concerned with the fear, the despondency and the hardship which result from uncertain economic existence. Control to a greater degree than now prevails might lead, however, to more extensive liberty of action, as control by stop-and-go signals has eliminated traffic jams and promoted free movement, or as control of infections has enormously expanded the liberties of mankind by providing safe food and drink and by isolating the carriers of disease. More control is tolerable if it results in greater human freedom.

Instant readiness for defense against dangerous and destructive enemies is also suggested by the body. We have noted that, when faced with the necessity of physical combat, almost every part of the organism is almost at once intensely aroused to defensive action and that, for gaining victory, mobilization of the internal forces is likely to reach the utmost limit. No "oxygen debt" is allowed to persist that might be a source of weakness if an emergency should arise. Again observe that security is a primary objective. In a world where predatory nations, powerfully armed, are ready to attack, the ideal of security often is not adequately respected. Internal forces are not trained for action. Protective instruments of warfare are lacking. At a time of crisis industry is obliged to begin to construct buildings and design tools and machines to manufacture the instruments which the crisis demands. Compare this unpreparedness with the preparedness of our bodies which through many generations of little use still retain the elaborate reactions of defense.

Physiological homeostasis would suggest, further, that stability is more important than economy. As previously remarked, excess of water or salt or sugar

is thrown away when derangement of a steady state is approached. The violent shivering which attends a fall of body temperature is, in terms of obvious accomplishment, wasteful of energy, because the muscular contractions do no external work. They are useful, however, in producing heat and thus keeping uniform the fluid matrix. Further evidence that security comes before economy is revealed by the wide margins of safety found throughout the organism. Extra blood volume, lung capacity, blood pressure and cardiac power—much more than ordinarily required—all indicate generous preparations for meeting unusual demands, which might create disorder if they were not met. In personal and governmental practice, also, the principle of preferring security to economy has been to some degree recognized. Life insurance and accident insurance may be paid year after year with no advantage except a sense of being protected. Fire departments are maintained, and armies and navies are kept in fighting trim at great expense, again with special regard for safety rather than economy.

The idea has been expressed that functional groups in the organism, *i.e.*, the various organs, compete with one another for nutriment. There is little evidence to support that idea, so long as the body is in a healthy and well-nourished condition. All groups receive adequate support, not only those which are routinely active, but also those which may be active at some time or occasionally. The reproductive organs offer a striking example of prolonged sustenance before and after functional service, and perhaps through an entire lifetime of no service whatever. Here again is illustrated a liberal treatment of valuable parts rather than strict economy.

In emergencies, when life is in peril, there is, as already observed, discriminative treatment of specific organs. Those on which the organism depends for the proper conduct of its external affairs and for the internal distribution of its supplies receive special care. During protracted starvation, for example, the brain and the heart remain unchanged in weight while other structures waste away in furnishing them with nutriment. And if there is a serious hemorrhage, which drops the arterial pressure and greatly reduces the circulation rate and thereby the oxygen delivery, the pressure is soon raised so that the flow is fast again in brain and heart; but this is effected at the expense of a normal blood supply to other parts, which suffer until the normal blood volume can be restored. In short, the agency which is on the alert for changes in the outer world and which reacts to these changes, and also the agency by which the fluid matrix as a common carrier is kept moving for aid to the body as a whole, despite privations, are supremely favored. In the body politic, likewise, administrative and distributive agents, charged with conducting important external or internal business, receive in time of crisis exceptional consideration. In warfare, for example, the general staff and the service of supply are protected from the perils of the fighting line. And in civil life members of essential functional groups are retained at their usual work instead of being drafted for military duty.

In surveying the evidence thus far presented we see that social, like biological organizations, are characterized by having external relations with the surrounding environment and internal relations among the operating parts or groups; that the higher biological organisms, composed of extraordinarily unstable stuff, have learned the secret of stability by developing wide margins of safety in their bodily structure and ample provisions for defense against dangerous foes, and preeminently by producing for their internal parts a common environment which is automatically held in a relatively uniform state by corrective factors set in action by delicate signals of deviation from that state. The body politic exhibits many processes which resemble those found in the body physiologic; the analogies are so close and so numerous, not only for nation but also for industry, as to intimate strongly that there are indeed general principles of organization, widely applicable to complex aggregations of collaborating parts. Although there are these analogous processes and systems in the social organization they are effective only within very broad limits in providing stable conditions. Without definite regulations for social homeostasis—without an equable flow of the necessities of life to all, without arrangements for variable demands for labor, without signals of economic danger when that danger impends—booms alternate with depressions, hunger alternates with abundance, and overtime work alternates with forced idleness. Also adequate defense against attack by insidious disease or by gross external foes is often neglected; and tight economy and maximal efficiency are demanded with little regard for the welfare of the units in the functioning groups on which the very existence of society must rest. In such respects the body physiologic has evolved methods of operation which are more efficient than those thus far prevailing in the body politic.

A question which properly arises is whether an organized control of the internal environment of society is consistent with human freedom. That control, would, indeed, involve assignment of power to store goods in times of plenty and to release them in times of need, to lay aside wage and job reserves to care for temporary unemployment, to train labor in new skills when they are required, to accelerate or retard essential processes of production and distribution according to demands or needs, to check perturbing and distressing shifts of price level, and to assure to all the opportunity for expert attention in case of illness or injury.

Analogous arrangements exist in our bodies, with the possibility of local control by functional groups, to be sure, but ultimately under a central, automatic, coordinating system. Precisely because that coordinating system is automatic we are free—free from consciously meeting the exigencies of a variable outer world, and from attending to harmful variations of the inner world of the organism. If we were not protected against these perturbing states we should be either compelled to remain inert in a carefully and uniformly regulated chamber, or checked at every move by the need of attentively avoiding such perils as coma or convulsions. Just because there is an inner homeostasis the higher functions of the brain are released for their special uses—for work and play, for adventures, for research and exploration, for the production and enjoyment of literature and art and for all manner of social interests.

We should recognize that the functioning of the human brain has made social homeostasis differ markedly from physiological homeostasis. By use of the brain in seeking new devices we as discoverers and inventors are occasionally changing the internal environment of social organizations. Only thus do we improve it. But an upset of constancy necessarily results. Railways replace canals, automobiles crowd out the horse and buggy, and now airplanes compete with previous means of travel. Such disruptive inventions profoundly derange the functional groups of a social system. Experienced workmen find that their skill can no longer be applied. During a period of transition thousands may be thrown out of work. Then the personal security which social homeostasis might provide would be, for many, sadly lacking. The brain, however, is not only an organ for discovery and invention; it is also an organ for adaptation and adjustment. As possessors of brains we should be able to apply them to finding ways to care for our fellowmen who will suffer from inventions having general social value. By planning employment which is expansible in non-technical directions, by extending processes of education and specialized training for new skills, by stimulating fresh enterprise, the distress due to penurious idleness can be greatly lessened. Already the humanity of such social conduct is being recognized by the state and by industry. A very important step towards establishing a sense of security will be taken when these and similar measures are regarded as necessary in order to avoid the harassing fears and anxieties and the needless pain of insecurity.

The peculiar service of the brain in adapting the organism to its external environment raises questions as to its rôle in the congeries of organs which constitute the body physiologic. Is the brain in a dictatorial position? Does its relation to the other organs suggest an unchecked dominance? It can, indeed, so act that it and all other organs of the body are destroyed, as in suicide. But if the brain performs its proper functions, it is revealed as acutely dependent on these other organs; a momentary inadequacy of the oxygen supply from lungs and heart abolishes the cerebral processes which are basic for consciousness, and a few minutes of that condition will produce irreparable damage, a state of idiocy. Idiocy results also if an almost incredibly minute amount of thyroid secretion is not routinely produced during the period of childhood. In short, the body physiologic is a collection of organs, the brain among them, which are interdependent and which, for the welfare of the whole, cooperate. Each one needs the others for perfect function.

The brain has almost no *direct* government of the autonomous homeostatic mechanisms; we can not, at will, increase sugar in the blood, accelerate the heart or stop the secretion of digestive glands. On the other hand, if the brain does so direct behavior in relation to outer circumstance that the organism is endangered, the corrective self-regulatory devices will be supremely stimulated. Fever, inflammatory barriers, antitoxic agents, corpuscular defenders, all arise to check infective incursions; and against attack by beast or man emotional reactions summon the forces of the entire body for physical effort. In either case the internal economy as a whole is placed on a survival basis; reserves are lavishly distributed; even portions of the organism itself may be destroyed in meeting the emergency. In these critical conditions the functions of the brain are no longer free; they are confined to solving problems of survival; and creative activities in art and science, apart from those problems, are largely obliterated.

Such disastrous consequences of human conduct have their analogues in the calamities which fall upon nations when governmental leaders act in such ways as to bring on war. The body politic, to be sure, like the body physiologic, is then unified, integrated, and for one purpose—self-preservation. Men are mobilized for military service; women are called by industry and commerce to replace the men; hours of work are lengthened; the arts of peace are neglected; scientists cease their untrammeled labors and concentrate on inquiries of importance for the army and navy; immense resources which might be used to carry comfort and conveniences to the under-privileged or to lessen ignorance and disease are appallingly spent in reckless and malicious destruction; the lives of tens of thousands of citizens are extinguished, and privation and misery become universal. In avoidance of these calamitous disruptions of social stability the problem is that of finding conditions which are least

likely to allow damage and destruction through acts of a functional group responsible for directing conduct related to external affairs.

Before touching on that problem we must consider an inevitable difference between the body physiologic and the body politic. The body physiologic must die. The body politic can live indefinitely. When death of the body physiologic occurs it results from failure of proper performance by one of its essential organs—for example, impaired activity or an ended service in kidneys, lungs or heart. Death is due, therefore, to dependence on irreplaceable parts. By substitution of new parts a machine may continue operating without limit of time. Likewise in social organization there can be unending continuity of efficient existence so long as there are arrangements for continual renewal of the functional groups. The body politic runs the risk of extinction, however, if one or other of its essential functional groups, like those of the body physiologic, is lacking proper provision for strong and useful replacement. There are illustrations of this possibility in the failure of a group in the body politic which is analogous to the brain in its highest functions.

The human cerebral cortex is the climax of biological evolution. The triumphs of its processes in solving the mysteries of natural phenomena, in transforming knowledge into power, in designing ingenious mechanisms, in making and using symbols in place of things, in providing means of perpetuating the past, and in guiding behavior through appropriate ways in the novel world which it creates, give the cortex the supreme position among the functional groups of the body. It happens, however, that among all the units of which our organs are composed the units of our nervous system are least replaceable, either immediately or by substitution. We have only a thin sheet of cortical tissue over the brain surface and it is so indispensable that if portions of it are damaged we may be paralyzed, or rendered blind or deaf or be utterly deranged. In the social body, also, the functional group which corresponds to the organ of intelligence —the revealers, the creators, the directors of affairs—are least easily replaced. It is of the utmost importance, therefore, that whenever unusual ability of social value is disclosed, no matter what its source, it should be allowed every chance to rise to its highest level of accomplishment. Thus the vigorous persistence of the social organism is best assured. Obviously the casting forth of highly gifted, irreplaceable units, its discoverers and interpreters, from a society, is an act partaking of social suicide. And obstacles placed in the ways of advancement to posts of managerial responsibility and direction, so that the members of the administrative group are not supplanted by able successors, may lead to disaster. In that direction revolutions lie, and the fall of dynasties and the distintegration of empires.

The success of the body physiologic would seem to intimate that in the body politic there should be a thorough cooperation of functional groups, with the administrative groups dependent, like the others, on a common welfare. And the failure of the body physiologic to survive would seem to emphasize the importance of adequate replacement of functional groups as an elemental necessity for the social body's persistence. Its firmest basis for longevity and stability would appear to be a generally accepted mode of replacement, socially sponsored as being orderly and just. When a leader is thus chosen for responsibility he becomes a temporary advocate for public opinion. And when he is no longer representative he in turn can be replaced. Thus, in a democratic society, the diffused functional groups have possibilities of continuing the life of the social organization and of controlling their own circumstances. When an arbitrary dictator seizes power these possibilities vanish. The circumstances are now dominated by the personal pride or ambition or whim of a single man. Experience has shown that the social body, like the human body, is integrated by martial emotions and by preparations for conflict. A dictator, therefore, praises military powers, and rouses martial emotions by pointing to national insecurity or national destiny, and finally drives on to open aggression. Thus he obtains the support of a unified people. But despotic domination lacks precisely what is required for continuance of despotic rule—provision for replacement by an equally despotic ruler.

The use of insecurity by dictators as a basis for rousing hopes and fears and hatreds well illustrates the plasticity of people when they are uneasy and anxious. When they are in dire want, or are uncertain of support, or are fearful of their future, they are easily persuaded by any one who firmly promises them relief. And if their distress is definitely attributed to a certain class or another nation, they are easily persuaded to hate and to call for vengeance. The unscrupulous demagogue grasps for power and becomes a menace because he knows that the needy are not free; he knows that they are sure to follow a course in which they are offered abundance. For any democratic society this situation is not without peril. Social homeostasis becomes, therefore, a consideration of prime significance. It is foolhardy to be smug and self-satisfied and disdainful of efforts to establish a more perfect social justice. As remarked before, human society is in the process of evolution, and probably is in what will be regarded as an early stage of that process. Stability of the internal environment of social organization has not been attained. So long

as men have not the right to work and earn their bread, so long as they are left ignorant of vital information, so long as they are ill and not attended, so long as they are in misery and wretchedness without care, further evolution of society should not only be expected but sought, not only advanced by trial and error but promoted by applied intelligence.

We have seen that conditions in the nation, in industries and in homes are intimately related. Harmful consequences of unsteadiness in the nation finally bring misery to the ultimate social units, ourselves and our fellows. But steadiness in society as a whole and steadiness in its members are also intimately related. Just in so far as social stability fosters security, both physical and mental, of the members of the social organization, so also it fosters their higher freedom, assuring them opportunity for self-support, replacing fear by confidence and providing for health and reasonable leisure. These are the prime conditions for wholesome living, for the enjoyment of natural and created values, for the discipline and exercise of individual aptitudes and for the pursuit and acquisition of new knowledge. They are prime conditions also for safety of the body politic.

OBITUARY

GLADWYN KINGSLEY NOBLE[1]

(September 20, 1894–December 9, 1940)

DR. GLADWYN KINGSLEY NOBLE died on December 9, 1940, at the age of forty-six. But his years were crowded with achievement and that must be remembered in mourning the loss of one of the most gifted and dynamic of men. More, the work he set in motion, which will extend his ideas and methods into the future, will be his continuing memorial.

Dr. Noble left behind him two great departments in the American Museum of Natural History. The Department of Herpetology's catalogue of specimens now includes more than 110,000 entries; while his Department of Experimental Biology, which crowds the two upper floors of the African Wing of the Museum, is the crowning achievement of his life. His results are recorded in 182 scientific papers and one invaluable text-book, "The Biology of the Amphibia." His first paper was published in 1913, while he was an undergraduate student at Harvard University; his last three papers may even now be coming off the press. During this period of twenty-seven years our always young friend took his several degrees at Harvard and Columbia, served a year in the United States Naval Reserves, was a lecturer in biology at Columbia University, was visiting professor of biology at New York University and Chicago University, and built up his two departments in the American Museum.

He took an active part in many scientific societies, especially the New York Academy of Sciences, the Society of Ichthyologists and Herpetologists, the American Association of Anatomists, the Society for Experimental Biology and Medicine. He was a corresponding member of the Zoological Society of London, an associate editor of the *Journal of Morphology* and one of the editors of *Biological Abstracts*. His field studies took him to various parts of North America, as well as to the West Indies and Peru; it was doubtless his intimate knowledge of the living animals in their own natural environments that contributed greatly to his success in rearing the same or related creatures in the laboratory. It was also this varied experience in the field and in the laboratory that enabled him to pose his experimental set-up in such ways that his animal subjects could give unequivocal answers.

At Harvard University Noble was a student of Dr. Thomas Barbour, who evidently succeeded in inspiring his pupil with an abiding interest in field studies, in thorough and sound taxonomic work, in the living creature and its individual and racial history. These qualities are evident in all of Noble's early papers on birds and reptiles, a number of which were prepared in collaboration with Dr. Barbour.

In many careers chance plays a conspicuous part. Noble's career was one of purpose and determination from his college days; in his relatively short life there was no lost period. He knew that in the long run the savings banks of learning and hard work pay cumulative dividends; figuratively speaking, he was always reinvesting his earnings to enlarge his plant and productive capacity. And assuredly his products became more valuable as they increased in number and diversity. As we follow his papers through the years, we see that he never ceased to broaden and deepen his interest in taxonomy; he was always searching for individual variations, varietal and subspecific differences, specific, generic, family, subordinal and ordinal characters; but having discovered and recorded these differences, the questions, how, why and by what steps led him to examine each fact from whatever points of view seemed most likely to be productive.

The first really great work that Noble produced was a classification and phylogeny of the frogs and toads. It is based on the analysis of a huge mass of data, patiently assembled from many sources, and an original and extensive examination of many specimens.

[1] A fuller notice of Dr. Noble's scientific work was given in an address by Dr. Gregory at a memorial meeting held at the American Museum of Natural History on December 19, 1940.

From these studies Noble drew up a revised classification illustrating the parallel modifications in the different suborders and from the vantage ground thus gained he went on to review the batrachian faunas of the different continents, tracing their spread from a northern origin.

Noble's exhibition work in herpetology culminated in 1927 with the opening of the Museum hall of living amphibians and reptiles; so far as possible at that time this hall embodied his conviction that the proper scope of a museum of natural history was not only to present faithful and beautiful representations of things as they are but especially to stimulate the quest for knowledge of underlying principles.

While Noble was growing up, so to speak, in his Department of Herpetology, he, with the rest of the scientific world, was becoming acutely aware of the importance of the endocrine glands and their secretions from infancy to old age. He soon saw the possibilities in this line as bearing on his own field of metamorphosis, growth and evolution in the amphibians and reptiles. The Department of Experimental Biology was created in 1927 in order to give him room and scope to carry on investigations into the complex effects of the endocrine secretions upon animal life and hundreds of thousands of experiments were conducted and recorded in papers by himself and his staff. Noble observed especially the strange ways of courtship and mating among animals and supported his observations by moving pictures of fishes, amphibians, lizards, snakes and birds, making their own unquestionable records of their lives. Observations which were formerly distributed among many different departments of science were brought by him into a general clearing-house of knowledge of living animals. More than any other man Noble was rapidly integrating these fragments into a continuous and understandable picture. Yet he was never in danger of confusing the part with the whole. Because hormones from the endocrine glands were, at least in some cases, the activating agents, he did not fail to search for other leading factors in the always complex results. Vertebrate animals being endowed with highly organized central nervous systems, it was next in order to study the reactions between the activating hormonal substances and the responding nervous controls. The complexity of a subject never intimidated Noble and he did not easily lose himself even in that incomparable labyrinth, the human brain.

From 1927 until his death near the end of 1940 Noble was directing and leading two active and successful departments, with their rapidly expanding parts and aspects, while at the same time keeping up his own researches and his published reports. In the midst of this broad program he was suddenly laid low. The entire scientific world will be one with his colleagues and friends in hoping that his work may go on as he planned it.

WILLIAM K. GREGORY
AMERICAN MUSEUM OF NATURAL HISTORY

SCIENTIFIC EVENTS

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE annual meeting of the Council of the Union of American Biological Societies was held in Philadelphia on Monday, December 30, at four o'clock in the afternoon.

During the past year the Union has continued to support projects of broad interest, as the promotion of *Biological Abstracts* and the teaching of biological sciences. Due to World War II, *Biological Abstracts* has suffered through cancellation of foreign subscriptions and has been operating on a reduced budget. This decrease in foreign income has been offset to a marked degree by increased subscriptions in the Americas due to the splendid efforts of the staff, section editors, collaborators, trustees and interested societies, as well as the individual biologists themselves. The American Society of Zoologists, Society of American Bacteriologists, American Physiological Society, American Society of Naturalists, Genetics Society of America and Society of American Foresters are contributing financially as well as editorially to the support of *Biological Abstracts*. Other societies are considering action. Further cooperative arrangements are desired by *Biological Abstracts*, since this organization is a cooperative, non-profit enterprise that was created to serve biologists the world over.

The Union's Committee on Biological Science Teaching, financed by a grant from the Carnegie Foundation for the Advancement of Teaching, is under the chairmanship of Dr. Oscar Riddle and includes the following members: E. V. Cowdry, F. L. Fitzpatrick, H. B. Glass, B. C. Gruenberg and E. W. Sinnott. This group, with the cooperation of its representative, D. F. Miller, earlier established the National Association of Biology Teachers, which has become a thriving organization sponsoring a journal, *The American Biology Teacher*. During the present year it distributed 16,000 questionnaires to teachers of biology in high schools of the United States and an analysis of the large amount of data secured from 3,200 replies is nearing completion. At least a preliminary report on certain important results of this investigation will be made to the Union at the annual meeting in Philadelphia.

During the course of the year the Union publicized,

through its secretary, an appeal for help for the National Central Library of China. Recently Mr. Chiang Fu-Tsung, the director of the National Central Library, requested further cooperation, as follows:

> Due to the restrictions on the purchase of foreign currencies by the Chinese government, the National Central Library is rendered helpless to buy foreign books to meet the increasing demands of our intellectually starved students and scholars. I have been writing to various friends in the U. S. A. to sound their opinion if a drive for book funds can be started. With those funds deposited in a bank in the U. S. A. the National Central Library will be thus enabled to buy the necessary books in America and Europe.

The Union will gladly serve as a collecting agency for these funds. Checks drawn to the China Book Fund may be sent to the secretary of the Union who will deposit them with the U. A. B. S. Treasurer pending the purchasing of books by the National Central Library of China.

GEORGE W. HUNTER, III
UNION OF AMERICAN BIOLOGICAL SOCIETIES

SCIENTIFIC EXPEDITIONS

A SCIENTIFIC expedition sponsored by Mrs. Anne Archbold in her yacht "Cheng Ho" left Suva, Fiji, for other islands in Melanesia on or about November 21. The party consists of Mrs. Archbold, Captain Skolfield, physician and master of the yacht; Miss Mary Keegan, registered nurse; R. Gucker Abbott, malacologist from Harvard; Otto Degener, representing the New York Botanical Gardens, and his assistant Emilio Ordonez; John Wesley Coulter, geographer, University of Hawaii, and John Swingle, photographer. The party will spend about four months in the field, visiting Gilbert and Ellice Islands, Ocean Island, Solomon Islands, Santa Cruz, New Hebrides and New Caledonia. Land shells collected by the malacologist will be sent to Dr. Montague Cooke, of the Bishop Museum, Honolulu, and to Professor J. W. Clench, Harvard University. Botanical specimens will be sent to Dr. Elmer D. Merrill, of the Arnold Arboretum, to Dr. William J. Robbins, of the New York Botanical Garden, to the U. S. Department of Agriculture in Washington and to other institutions.

An Associated Press dispatch states that three members of the Fahnestock expedition, Mrs. Bruce Fahnestock, her son, Sheridan, and his wife, have returned from the South Seas and are organizing a new cruise in search of rare Pacific birds. The expedition, sponsored by the Whitney Memorial Hall of Pacific bird life on behalf of the American Museum of Natural History, left New York in February. The proposed two-year cruise was cut short on October 18 when the 140-foot schooner *Director II* struck a reef east of Australia and sank.

It is reported in *The New York Times* that the resources of Latin America will be studied this winter, in the interests of Western Hemisphere defense, by eight experts sent by the Department of the Interior to survey the deposits of such minerals as manganese and chromite, tin, tungsten and antimony. Of the eight geologists, all of whom are members of the staff of the Geological Survey, five already are in the field, one is on the way and two are awaiting the completion of arrangements with the government of the country to which they have been assigned.

S. R. Capps will make a three-months survey of the manganese deposits of Brazil, where W. D. Johnson, Jr., already is looking for chromite. C. F. Parks, Jr., and T. P. Thayer are in Cuba, studying deposits of manganese and chromite there, while in Bolivia surveys for tin are being made by E. Callighan, with J. F. McAllister making surveys on tungsten and antimony. Through the State Department the Cuban and Brazilian Governments have offered their cooperation in the geological investigations, extending the courtesy of travel on the railroads without cost to the United States Government.

HIGH-VOLTAGE TRANSMISSION LABORATORY AT CORNELL UNIVERSITY

CONSTRUCTION of a new $150,000 laboratory for the College of Engineering of Cornell University designed primarily for research in problems of high-voltage transmission has been authorized by the Board of Trustees.

The laboratory will be used for research into the properties of air and other electrical insulating materials. According to Dr. W. A. Lewis, Jr., director of the School of Electrical Engineering, who will supervise the program, "One of the important problems to be investigated is that of corona, the halo or glow which may surround conductors at high voltages, indicating leakage of electricity to the surrounding atmosphere. Between the empirical work of the practical engineer and the small-scale experiments of the physicist is a large unexplored region where precise investigation and analysis may reveal much of importance in power transmission and throw light on the general properties of materials under electrical tension."

The building, according to Dean S. C. Hollister, will be 72 by 120 feet, and 55 feet high, of steel construction throughout, providing an electro-static shield to keep the effects of high voltages within the laboratory. Connected with it will be a half-mile voltage transmission line. The laboratory will be built on university property near the East Ithaca station, with highway and rail facilities.

It will be provided with both 60 cycle and impulse testing equipment. The former will be used in re-

search on problems which arise within the transmission lines, transformers and machines of the power system, and the latter for research on effects which come from outside the power lines, such as those caused by lightning. The 60-cycle equipment will be capable of providing a voltage of 750,000 volts single phase, of 433,000 volts three phase, which is sufficiently high to test equipment for higher voltages than any now in commercial use. The maximum now used in the United States is 287,500 volts at Boulder Dam. The impulse testing equipment in the new laboratory will simulate natural lightning up to a maximum of 3,000,000 volts. There is no comparable laboratory in any university east of the Rockies and there is only one with similar facilities on the Pacific Coast.

Besides the research program, the laboratory staff will undertake tests of apparatus for commercial purposes, such as insulators, bushings, switching equipment and transformers. It is planned to extend a spur of the Lehigh Valley Railroad tracks into the laboratory, so that large pieces of equipment may be brought in and tested without being removed from the freight cars.

Power will be applied from the University Power Plant, where the necessary facilities are already available. A motor generator will be inserted in the line so that effects of the laboratory will not be reflected back into the university lighting system. Construction of the entire project will begin at an early date.

THE INDUSTRIAL X-RAY UNIT OF THE GENERAL ELECTRIC COMPANY

AN x-ray unit, producing energy equal to $90,000,000 worth of radium, was dedicated on December 17 by the General Electric Company as part of its program commemorating the fortieth anniversary of its research laboratory. Rated at 1,000,000 volts, the unit exceeds by 600,000 volts the rating of the largest previous industrial unit and cuts the time of taking a picture through four inches of steel three feet away from one hour to less than two minutes.

The new equipment will greatly speed up the vital inspection of great steel castings used in mammoth turbines, in all high-pressure marine turbines, and in countless other ways to insure high quality in prime mover machinery. X-ray examination of steel castings has been an established practice for several years. Through application of this method, flaws which would otherwise pass undetected are discovered and rectified before the machinery goes into actual service. Many thousands of dollars have been saved industry through the use of x-rays.

Until now, the largest industrial unit in use anywhere in the world has been a 400,000-volt unit now superseded by the new outfit in the Schenectady works of the General Electric Company. With the new million-volt unit, an exposure of less than two minutes accomplishes the purpose. With the 400,000-volt unit, three hours and a half were required to make a picture through five inches of steel. With the new one, only five minutes are required. The exposure time must be increased two and one-half times per inch of steel to be pictured.

The unit is housed in a special building of its own. Unique construction features are employed to make it the safest possible building for the operation of high-voltage x-ray equipment. For example, the walls of the structure are of solid concrete, 14 inches thick, plus 12 inches of brick on the interior, making a total thickness of more than two feet or the equivalent of approximately four inches of lead. To further prevent any stray x-rays from escaping into surrounding manufacturing buildings, the foundations of the structure extend five feet below the surface of the ground in a solid mass. With such protection, all possible chances of the still mysterious x-rays causing personal injury to any one working in the vicinity are eliminated.

GRANTS OF THE CARNEGIE CORPORATION OF NEW YORK

ACCORDING to the annual report of Dr. Frederick P. Keppel, president of the Carnegie Corporation, grants amounting to $4,692,682 were made during 1939–40. Of this sum $347,520 was appropriated for library interests, $218,000 for adult education, $459,500 for the arts, $2,026,947 for research, studies and publication and $1,613,715 for general interests.

Appropriations for scientific work listed in the appendix of the report include:

University of Montreal, the development of library of Botanical Institute. $8,000.

Montreal Botanical Garden, the development of library and educational program. $6,200.

New York Museum of Science and Industry. $40,000.

American Association of Museums. $37,000.

American Museum of Health, studies in the field of health education. $30,000.

Carnegie Foundation for the Advancement of Teaching, for the development of the program in mental hygiene and education. $5,000.

Carnegie Institution of Washington. $982,000.

The Johns Hopkins University, research in embryology. $7,500.

The Massachusetts Institute of Technology, high voltage nuclear research project. $6,000.

National Research Council. $105,000.

National Academy of Sciences. $50,000.

Australian National Research Council, anthropological research. $10,000.

American Neurological Association, research on heredity of mental diseases. $3,000.

Dental Research, various institutions. $173,000.

Harvard University, endowment of the School of Dental Medicine. $650,000.

University of Adelaide, lectureships in chemistry and mathematics. $5,600.

National Committee for Mental Hygiene. $8,000.

National Tuberculosis Association, to facilitate international standardization of tuberculin. $3,000.

Experimental program in human biology, in North Carolina. $10,000.

It is stated that during the fiscal year the corporation made grants for research, study or travel to 129 individuals resident in the United States or in one of the British Dominions or Colonies, as compared with 138 grants offered during the previous year. While the total devoted to these purposes was substantially less than in 1938–39 ($238,000 as against $286,000), it represents a slightly higher proportion of the sum available for appropriation this year. In addition, 324 allocations, chiefly for resident study, were made by eighteen universities and operating agencies from funds provided by the corporation. In most instances, these latter grants were charged to appropriations made and paid to the appointing institution or agency in prior years.

The decline both in the number of grants and in the aggregate sum is explained in the report partly by a decline in income which of necessity was reflected in all corporation operations, partly by the concern of many scholars with matters relating to national defense, and partly by restrictions on travel imposed by the war. The latter factor necessitated almost complete suspension of the program of exchange of visits between the British Dominions and Colonies and the United States.

SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science and some forty affiliated and associated societies held their annual meeting in Philadelphia from December 27 to January 2. The address of the retiring president, Dr. Walter B. Cannon, is printed in the present issue of SCIENCE. This will be followed by other addresses of special interest. A general report of the meeting, edited by Dr. F. R. Moulton, permanent secretary of the association, will be printed in the first issue of February.

THE DeKalb Agricultural Association, Inc., Illinois, gave on November 29 a banquet at the Palmer House, Chicago, in honor of Dr. George Harrison Shull, at which he was awarded a diamond-studded gold medal in recognition of "his outstanding contribution to agriculture, the origination of hybrid corn." Speakers at the banquet included Dr. C. M. Woodworth, of the University of Illinois; Dr. A. M. Brunson, of Purdue University; Marco Morrow, of Topeka, Kansas, and the Honorable Lloyd C. Stark, Governor of Missouri. At the close of the banquet Dr. Shull gave an illustrated address covering not only his work with hybrid corn, but also his current investigations of the genetics of Capsella and Oenothera.

DR. R. G. D. RICHARDSON, professor of mathematics and dean of the Graduate School at Brown University, has retired as secretary of the American Mathematical Society after serving for twenty years. At the Baton Rouge meeting, in recognition of his great services, the society presented him with a commemorative gift and a resolution of thanks. It was decided that the next volume of the yearly *Bulletin* of the society should be dedicated to him.

THE Alexander Portnoff bust of John Dewey, professor of philosophy emeritus at Columbia University, has been presented to the University of Chicago. It will be placed in the Graduate Education Building in commemoration of his years of service to the university.

THE alumni association of the School of Medicine of the University of North Carolina, Chapel Hill, recently presented to the university a portrait of Dr. Isaac H. Manning, Kenan professor emeritus of physiology and a former dean of the school. Dr. William Raney Stanford, Durham, a former student under Dr. Manning, made the presentation and President Frank P. Graham accepted for the university.

DR. BÉLA SCHICK, pediatrician-in-chief at the Mount Sinai Hospital, New York City, will be presented with a gold medal in recognition of "distinguished and outstanding contributions in the field of allergy" at the Third Annual Forum reviewing progress in the chemical study of allergy, which will be held at Indianapolis on January 11 and 12.

DR. J. CHESTER BRADLEY, professor of entomology at Cornell University, has been elected a corresponding member of the Sociedad Cientifica Argentina.

THE A. Cressy Morrison prize of $500 of the New York Academy of Sciences has been divided between Dr. Hans A. Bethe, professor of physics at Cornell University, and Dr. Robert E. Marshak, instructor in physics at the University of Rochester, for a joint paper entitled "The Sources of Stellar Energy."

DIRECTORS of the American Chemical Society elected for a term of three years are: Dr. Willard H. Dow, president of the Dow Chemical Company, Midland, Mich., to succeed himself; Dr. Robert E. Wilson, president of the Pan-American Petroleum and Transport Company, New York City, to succeed Erle M. Billings,

of the Eastman Kodak Company, and Professor Roger Adams, head of the department of chemistry of the University of Illinois and past president of the society, to succeed Professor H. H. Willard, of the University of Michigan.

COUNCILORS-AT-LARGE of the American Chemical Society elected for a term of three years are: Dr. William Mansfield Clark, De Lamar professor of physiological chemistry at the Johns Hopkins University; Dr. Joel Henry Hildebrand, professor of chemistry at the University of California; Dr. G. E. F. Lundell, chief chemist of the National Bureau of Standards, and Dr. Charles A. Thomas, director of research at the Thomas and Hochwalt Laboratories of the Monsanto Chemical Company, Dayton, Ohio.

OFFICERS of the New Jersey Gastroenterological Society, an affiliated chapter of the National Gastroenterological Association, have been elected as follows: *President,* Dr. Hyman I. Goldstein, Camden; *Vice-president,* Dr. Harrison R. Wesson, Montclair; *Secretary-Treasurer,* Dr. Sydney Rosenthal, Newark; *Delegate,* Dr. Sigurd W. Johnsen, Passaic. A public meeting will be held on Monday evening, February 3, at the Newark Academy of Medicine, when a symposium will be presented on "Ulcers of the Stomach and Duodenum."

THE election of Sir Henry Dale, director of the British National Institute for Medical Research, as president of the Royal Society, London, has already been announced in SCIENCE. T. R. Merton, formerly professor of spectroscopy at the University of Oxford, has been elected treasurer; Professor A. V. Hill, Foulerton research professor of the Royal Society, and Professor A. C. G. Egerton, professor of chemical technology at the Imperial College of Science and Technology, have been elected secretaries; Sir Henry Tizard, rector of the Imperial College of Science and Technology, has been elected foreign secretary. Other members of the council elected are Professor P. M. S. Blackett, Professor F. T. Brooks, Dr. C. G. Darwin, Dr. A. N. Drury, Dr. H. J. Gough, Professor J. B. S. Haldane, Professor I. M. Heilbron, Professor O. T. Jones, Professor R. T. Leiper, Sir Thomas Middleton, Professor L. J. Mordell, Dr. C. F. A. Pantin, Professor H. S. Raper, Professor E. K. Rideal, Dr. F. J. W. Roughton and Professor A. M. Tyndall.

DR. BENNETT F. AVERY, of the department of anatomy at the American University, Beirut, Syria, has been elected dean of the Medical School of Boston University to succeed the late Dean Alexander S. Begg.

PROFESSOR CHESTER S. HUTCHISON, of the department of agricultural education, has been appointed junior dean of the College of Agriculture of the Ohio State University. Mr. Hutchison succeeds Dr. Lyman E. Jackson, who has taken up his work as president of the South Dakota State College of Agriculture and Mechanic Arts.

DR. FRANCIS O. SCHMITT, head of the department of zoology at Washington University, St. Louis, has been appointed professor in charge of biological engineering at the Massachusetts Institute of Technology.

DR. CHARLES H. PECKHAM, obstetrician-in-chief of the Mary Imogene Bassett Hospital, has been appointed associate professor of obstetrics at the Medical School of the Johns Hopkins University.

DR. WILFRED HUDSON OSGOOD, for more than thirty-one years a member of the staff of the Field Museum of Natural History and chief curator of the department of zoology since 1921, retired from active service on December 31. Dr. Osgood remains, however, as chief curator emeritus. He will be succeeded as chief curator of the department of zoology by Karl P. Schmidt, whose appointment became effective on January 1.

LEONARD SMITH has been appointed a research associate of the Textile Foundation at the National Bureau of Standards, Washington, D. C.

DR. JOHN A. TOOMEY, professor of clinical pediatrics and contagious diseases in the School of Medicine of Western University, has received a grant of $1,000 for the continuation of his work on poliomyelitis supplementary to the $2,760 already made to him this year by the National Foundation for Infantile Paralysis, the organization which gathers its funds at the birthday party of President Roosevelt.

THE American Medical Association has made a grant to Dr. Siegbert Bornstein, of the department of bacteriology and serology of the Beth Israel Hospital, New York City, in aid of his work on the serology and epidemiology of American Salmonella.

AT the request of the Navy Department, Dr. Raymond L. Ditmars, curator of reptiles and of the department of insects of the New York Zoological Park, has prepared a report on the venomous snakes found in Central and South American areas where air bases may be established, and on the types of anti-venin serum that should be available at the bases.

DR. EDWARD A. DOISY, professor of biological chemistry and director of the department of chemistry at the School of Medicine of St. Louis University, delivered the third annual Lower Lecture of the Academy of Medicine of Cleveland on November 15. He spoke on "Vitamin K and Other Antihemorrhagic Compounds."

FAIRFIELD OSBORN, president of the New York Zoological Park, spoke recently over the short-wave radio

of the Columbia Broadcasting Company. His subject was "What America Owes to British Naturalists."

DR. ALEXANDER SILVERMAN, head of the department of chemistry of the University of Pittsburgh, lectured at the Franklin Institute, Philadelphia, on December 18. The title of his lecture was "Glass: To-day and To-morrow."

THE Philadelphia College of Pharmacy and Science is making available to graduates in pharmacy a brief but thorough review of the latest developments in that profession and in chemistry, bacteriology, biology and other sciences related to public health. A three-day seminar will be held at the Philadelphia College of Pharmacy on January 27, 28 and 29, at which time the mid-year recess of regular classes will allow the members of the faculty to devote their entire time to these lectures and laboratory demonstrations.

THE civil-service examinations for physicists announced on November 14, 1940, have not produced enough applicants. The announcements have been amended by the United States Civil Service Commission to extend the closing dates for receipt of applications for nearly a year until December 12, 1941. Only one application need now be filed at the Washington office by those wishing to apply for two or more positions. The positions to be filled include the following grades: Physicist (any specialized branch), $3,800 a year; also principal, $5,600; senior, $4,600; associate, $3,200, and assistant, $2,600 a year. These salaries are subject to a 3½ per cent. retirement deduction. The same conditions hold for the examinations which closed in September for the positions of metallurgist and metallurgical engineer, various grades, with salaries ranging from $5,600 to $3,200 a year. Difficulty also is being encountered in filling positions in the Bureau of Mines in connection with the National Defense Program for the development of strategic metals. Applications will be accepted until December 31, 1941. Applications for the various grades of explosives chemist with salaries ranging from $2,600 to $5,600 a year will be open until November 30, 1941. For none of these examinations is a written test required. Further information and the proper application forms may be obtained from the Secretary, Board of U. S. Civil Service Examiners, at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

MR. AND MRS. ROBERT WOODS BLISS have given sixteen acres of their estate of Dumbarton Oaks with the Bliss mansion, the gallery, library buildings and the Bliss collection to Harvard University. They have also transferred to the Federal Government for a public park twenty-seven acres of the estate adjoining Montrose Park.

WE have received the following communication dated in August from Professor Ding U Doo, director of the library of the Sun Yat-Sen University: "This is to inform you that the National Sun Yat-Sen University Library after a long journey, through thick and thin, has finally removed from Canton to Chengkiang, Yunnan and back to Nan-Ssun, Kwangtung. As we departed from Canton at the eleventh hour, a large part of our books were left behind to an unknown destiny. We have suffered an incalculable loss, unprecedented in the history of libraries. However, we are by no means down-hearted. We are standing firm and working hard for our recovery, looking forward to the final victory of the war, which is bound to be ours. We sincerely anticipate your sympathy over our hard luck and shall appreciate your continuous help and generous gifts as you have shown us in the past. You will please correct our address in your mailing list and favor us with your publications, new and old, which will be much needed and most useful to our faculty and students."

WE are also informed by a correspondent that "The Shanghai Medical College is now in Chungking working in close cooperation with the Central Hospital and Central Field Health Station of Weishengshu. National Chungshan Medical College is moving to Nanhsiung in Kwangtung, Tungchi to Yiping in Szechwan, and Chungcheng to Chen-ning, Kweichow, not far from Kweiyang, leaving only the Yunnan University Medical College in the vicinity of Kunming. On the other hand, Chungking is becoming a quite important medical center with the presence of the National Medical College of Shanghai, in addition to National Kiangsu Medical College, National College of Pharmacy, National Midwifery School and the Central School of Nursing previously established in this city."

DISCUSSION

A NEW RADIOACTIVE SERIES

DURING the investigation by mass-spectrographic methods of some in a geological sense old minerals of the tantalo-niobato group, which also contain some uranium, thorium, and rare-earth metals, a mass-line 237 has been found on several different plates. From no other material has a mass-line 237 ever been obtained, although a great number of minerals have been investigated with the same apparatus and under similar conditions. This mass-line 237 does not belong to any so far known chemical element or isotope.

It is significant that the mass-line 237 does not occur

either on mass-spectra of a pure uraninite from Varuträsk, northern Sweden, which is probably of slightly older age than the minerals investigated, or on the mass-spectra published by Nier of the uranium isotopes from uraninite from Wilberforce, Canada. Neither is it visible on mass-spectra taken of two monazites of about the same age. It is, therefore, not probable that this mass-line 237 belongs to any isotope of 90 thorium or 92 uranium, and since it has so far been found only in the tantalo-niobates it is most probable that it belongs to an isotope of the chemical element of the odd number 91 "Eca-Tantalum."

The mass-line 237 must belong to an element which is radioactive, since all known elements and isotopes in this part of the system of elements are radioactive. On account of its odd mass-number it can not, however, belong to the uranium- or the thorium-series, the members of which all have even mass-numbers. The members of the actino-uranium series have all odd numbers, but these numbers are all 4 n smaller than 235, where n is from 1 to 7, and the ultimate decay product is lead 207. Were not actino-uranium itself but an element of larger mass, the mother element of the actino-uranium series, such element ought to have the mass 239, but a transition product of mass 237 can not occur in the actino-uranium series. *The mass-line 237 must thus belong to an element, which is a member of a so far unknown radioactive series.* This element 237 may be either the parent element of such a new series, or originate from a uranium isotope, so far unknown, which had already decayed at a time before the uranium minerals investigated had been formed.

As an ultimate stable product of such a fourth radioactive series we should by analogy with the three other radioactive series expect to find lead of mass 205 or 209. Now Aston had in earlier papers ascribed two such isotopes to common lead (0,03 per cent. of 205 and 0,85 per cent. of 209), but seeing that these were not obtained by Bainbridge and Jordan, also Aston has later been of the opinion that they do not exist in ordinary lead. The very exact measurements by Nier show that the limit to which they could be present in the ordinary lead investigated by him does not exceed 0,01 per cent. for 205 and 0,0009 per cent. for 209. The limiting value for 205 is, as will be seen, fairly high, compared, for instance, with the percentage of radioactive potassium 40 in ordinary potassium (0,012 per cent.) and of uranium II in uranium (0,006 per cent.). Neither has the present author ever observed any lines 205 and 209 on the mass-spectra he has taken of ordinary lead from old Fennoscandian galenas. Some of the spectra containing the mass-line 237, however, show also a weak line at 205 besides Pb 206, 207 and 208, but from some of these spectra photometric results can not be obtained on account of the strength of the neighboring Hg-line 204. The occurrence of a mass-line 205 or the spectra containing mass-line 237 would indicate the presence in the two old tantalo-niobates investigated of an early member of this new, fourth radioactive series together with the stable endproduct of this series lead 205.

Further investigations in order to separate and enrich the uranium-, eca-tantalum-, thorium- and lead-groups from these minerals are being undertaken in order to obtain further information, but the uncertain conditions during the European war, which now as earlier at any moment may lead to conditions in which research work is interrupted, makes it necessary to communicate already at this stage the observations made.

WALTER WAHL

CHEMICAL LABORATORY,
UNIVERSITY OF HELSINGFORS

The communication by Professor Wahl was read as part of a discussion of papers by Professor Nier at the Conference on Nuclear Physics on October 30. It is worth noting that the work by Professor Nier upon the isotopes of lead which has been so interesting to geologists has, with one exception, not been upon lead derived from the minerals of the tantalo-niobate group. It is, therefore, important that more work be done along this line, and in another letter Professor Wahl expresses his keen desire to have duplicate material to check his work with Professor Nier. This is of course a problem for the Committee on the Measurement of Geologic Time, which met at the same time as the conference, and if there are any who have leads derived from this group of minerals or who have material which would be available, I should be very glad to hear from them.

ALFRED C. LANE,
Chairman, National Research Committee on Measurement of Geologic Time

PLANS FOR THE FUTURE OF THE VIRGINIA ACADEMY OF SCIENCE

THE responsibility of organized science to society, and its failure to fully accept this responsibility, is a matter that has given us concern for many years. Obviously, organizations in the specialized sciences, such as the American Chemical Society, American Association of Zoologists, etc., can contribute only in their respective fields of activity. More inclusive organizations, however, some of them embracing the best talent in practically all the branches of science represented in their community, city or even state, have frequently ideal opportunity for helping in the solution of pressing problems. Further, we believe the

spirit of *noblesse oblige* should have a large share in determining the activities of such groups once they have become strongly entrenched in public confidence and esteem.

Well-set-up state academies of science, with the more or less detached point of view inherent in them, are typical examples of such organizations as may be of great practical service, both in projecting new activities of state-wide concern without conflict with other existing organizations, and in contributing helpfully to worth-while activities already set up and at work.

Such was the idea that motivated us in asking the Virginia Academy of Science to give us the privilege of appointing carefully selected groups of men and women to think their way through Virginia's many problems and to help in developing a long-range program through which our organization might serve the state over a long period of years.

Before the appointment of such committees, the entire membership was asked two questions, as follows:

1. What, in your judgment, should be the primary objectives of a State Academy of Science?

2. Please outline rather carefully, and in order of their importance, three or more distinct contributions that the academy may and should make to Virginia in the next five years.

Replies to these questions were ample and full enough to give us a clear understanding of what projects such committees might study intensively. Not satisfied to trust these suggestions without supporting evidence from other groups, the same questions—with full explanatory letters—were sent to all Academy of Science secretaries in the country, all members of the National Association of Science Writers, and to a selected group of distinguished men and women whose influence carries weight in national and international scientific affairs. Replies from these sources were strikingly full and constructive. With these data in hand, thoroughly abstracted and tabulated, we undertook the most difficult task in connection with this plan, namely, the selection of the personnel of the Long Range Planning Committee, upon whom would rest the responsibility of doing most of the work.

The mechanics: Twenty of the most experienced and interested members of the academy were asked to nominate five or more individuals who, in their judgment, would be satisfactory members of such a group. This brought a hundred available nominees in no way limited to academy membership. From this list, with the aid of a committee of four, the group was chosen.

The interests of its personnel should become a part of this paper: Editors of two of Virginia's best-known newspapers, one of whom has been president of the Virginia State Chamber of Commerce; a member of the Governor's State Planning Board; the State geologist; the superintendent of public instruction in Virginia and the executive secretary of the Virginia Education Association; the publicity director of the State Chamber of Commerce; the dean of the University of Virginia; chief chemist of the Virginia State Department of Agriculture; the executive vice-president of one of our large tobacco by-products organizations; the president of Virginia Polytechnic Institute; the assistant director of research in the American Tobacco Company; a leading Virginia surgeon; the president of a leading woman's college; a professor of psychology of the University of Virginia, who is chairman of the research committee of the academy; a distinguished publicist—retired—but who devotes himself wholeheartedly to state-wide projects which have their roots in science; the president of Virginia's largest chemical and laboratory supply firm; and three chemistry department heads of Virginia colleges.

In addition to the Long Range Planning Committee, it has been deemed wise to appoint what is being known as the "Consultants" group of 23 men and women who expressed their willingness to help the committee whenever their services might be required. They represent a cross section of the most distinguished Virginians in their respective fields. It would seem of considerable significance that in making up these committees of 42 men and women, only one individual declined appointment and this on the ground that the war work in which he is engaged would make his acceptance impractical.

It has taken several months to gather the data and tabulate them, select committees and in other ways perfect the organization, but the machinery is now well set up and ready to begin the selection of the problems for immediate and future study.

Throughout all this planning we have kept before us certain objectives. In the first place we have attempted to acquaint leading laymen in Virginia with what the academy is, and with their cooperation what it hopes to become as an agent for constructive service. Second, through the State Board of Education, Virginia Education Association, the State Planning Board, industry, professional and academic institutions, and other agencies, to integrate as far as possible study of and work on such problems as might come well within the province of academy activities.

That the plan is fully worth-while is well attested by the cordial approval it has received from hundreds of men and women whose wisdom and experience entitle them to the confidence we have had in their advice. What the future holds for such a broad and long-range plan depends, of course, upon the wisdom,

sustained enthusiasm and industry of that small group making up the committee, to the selection of which the academy has given so much earnest consideration.

WORTLEY F. RUDD,
President

VIRGINIA ACADEMY OF SCIENCE

THE PRESENTATION OF SCIENTIFIC PAPERS

IN listening to the reading of scientific papers I have often experienced difficulty in following the author's train of thought, because of the too conscious effort I have had to exert to hear his words. The difficulty is not in my ears, for I have not yet lost the notes of such birds as the golden-crowned kinglet and the grasshopper sparrow. The trouble is not with the reception, but with the delivery, and I know I am not alone in the—I had almost said exasperation—I feel in hearing a good paper spoiled in the delivery. I have particularly in mind the last meeting of the American Ornithologists' Union. Fortunately, many of the speakers at that meeting spoke distinctly and well, and among these I remember particularly a woman member who took the center of the platform, held her head up and her manuscript at just the right distance, and read distinctly in a clear voice that carried to all parts of the hall. When I hear a paper so delivered I wonder why such an example is not more generally followed.

The purpose of this letter, however, is not simply to complain, but to offer a concrete suggestion. That is, that all inexperienced speakers—yes, and some that are not without experience—should get advice from the more experienced before undertaking to address an audience. I am sure it is not a matter of embarrassment or lack of confidence with most of the offenders. It is simply that they do not realize how unsuccessful they are in making themselves intelligible, nor do they know how to cure their faults of enunciation and expression. Doubtless some speakers need more than a word of advice, need a real lesson or even a course of lessons to teach them to open their mouths, use vocal cords, lips and tongue correctly, and keep the voice up at the end of each sentence. Of course we don't want oratory, and this letter is not written with the object of promoting the business of teachers of elocution! What we have a right to ask of our speakers, I think, is the acquirement of a clear and common-sense manner of communicating their information and ideas to an intelligent audience.

FRANCIS H. ALLEN

WEST ROXBURY, MASS.

SCIENTIFIC BOOKS

SEDIMENTARY PETROGRAPHY

Sedimentary Petrography, with Special Reference to Petrographic Methods of Correlation of Strata, Petroleum Technology and Other Economic Applications of Geology. Third edition, completely revised. By HENRY B. MILNER. London: Thomas Murby and Company; New York: Nordeman Publishing Company (Inc.). 666+xxiii pages; price, $10.00. 1940.

THIS third edition of Milner's standard text and reference book on sedimentary petrology has been partly rewritten and much new material has been added to include the latest developments in this relatively new and rapidly growing branch of petrography. About 150 pages have been added to the text, and, in addition, the size of the book has been increased from crown 8vo to demy 8vo.

In the new edition the problem of sampling is treated in more detail than in the former editions. Methods of preparing thin sections of friable and porous samples are discussed. A chapter on mechanical analyses has been added. Such methods of mineral concentration as the electrostatic, dielectric and flotation are described, and x-ray, fluorescence and microchemical methods of study are discussed. The section on methods of testing sedimentary rocks—for such properties as acid solubility, density, porosity, etc.—has been elaborated. Many more minerals are included in the section of diagnostic properties of the minerals. A section on applied petrography has been added in which are discussed such subjects as stratigraphic correlation, oil geology, ceramics, criminology, industrial maladies, etc.

The book is in large part a discussion of the methods and technic found by the author useful in the study of the loose detrital sediments. The methods of separating and studying the heavy mineral fraction from such rocks are discussed in detail, and many pages are devoted to a description of the diagnostic properties of the minerals found in sedimentary rocks. Some space is devoted to sampling, the study of consolidated sediments and mechanical analyses. Several chapters are devoted to the application of sedimentary petrology, to such problems as the correlation of sediments, soils and economic problems.

The book is an excellent, well-balanced treatment of the history, technique, methods, principles and economic application of sedimentary petrology. It is very well illustrated and contains excellent and extensive references to the literature.

ESPER S. LARSEN

HARVARD UNIVERSITY

MARINE SHELLS OF THE SOUTHWEST COAST OF FLORIDA

Marine Shells of the Southwest Coast of Florida. By LOUISE M. PERRY. No 95, *Bulletin of American Paleontology,* Paleontological Research Institution, Ithaca, N. Y., 260 pp., 39 pls., 6 text figures and frontispiece. 1940. Paper cover, $3.50; board cover, $4.50.

THIS volume contains descriptions of 346 shells, of which 3 are Loricata (coat-of-mail shells); 161 Pelecypoda (bivalves); 6 Scaphapoda (tooth shells), and 176 Gastropoda (univalves).

I know of no contribution that will be hailed with more pleasure by the flock of nature lovers that throng the beaches of the west coast of Florida every winter than the present volume.

Dr. Perry, for almost a quarter of a century, has been a beach-comber herself; becoming fascinated by the subject, she has not only searched the flotsam and jetsam of the beaches about Sanibel Island, the richest marine collecting ground in America, but has devoted much time to dredging, thereby bringing to light the denizens of the deeper waters. By this combined effort she has accumulated the finest collection secured in this region and an endless amount of information about the ecologic adjustment, seasonal migration and life histories of mollusks, as well as the means of securing and preparing these creatures for the cabinet. All this information has been condensed in the pages of her book. Her descriptions are simply told, concise and to the point, and the illustrations will give pleasure to the picture-minded amateur seeking a name for some new-found treasure.

It is to be hoped, now that the more obvious larger forms have been adequately treated, that Dr. Perry will direct her attention to the minute forms, for example, the members of the families Pyramidellidae, Cerithiopsidae, Rissoideae, etc., which are greatly in need of revision.

We congratulate the collectors of Florida shells for having this new tool available, and compliment its author.

PAUL BARTSCH

U. S. NATIONAL MUSEUM

SPECIAL ARTICLES

THE EXCRETION OF SPECIFIC FLUORESCENT SUBSTANCES IN THE URINE IN PELLAGRA

IN a recent publication Najjar and Wood[1] described a specific reaction in urine which was apparently dependent upon the store of nicotinic acid in the body. When urine was adsorbed on zeolite and subsequently eluted with KCl, the eluate on treatment with NaOH developed a bluish fluorescence. The substance responsible for this bluish fluorescence was not identified chemically, but could be measured quantitatively by means of a fluophotometer. Its fluorescent spectrum was published. It was shown that after the ingestion of nicotinic acid the excretion of this substance increased. It was suggested that in pellagra the excretion of this material might be diminished or absent, and that the quantity of this material excreted in the urine might serve as a measure of the deficiency of nicotinic acid. An opportunity to study pellagra patients had not, however, been obtained at the time of our previous publication.

Since then we have been able to study[2] four patients with typical pellagra. In one of these the symptoms were relatively mild; in two they were of moderate severity and in a fourth case they were unusually severe. None of these four patients, studied before treatment was commenced, excreted any of the material described by us giving the characteristic fluorescence on the addition of alkali to the urine eluate. A fifth pellagra patient, recently studied in Baltimore, likewise failed to excrete any of this material, as did also two dogs suffering from canine black tongue. It would, therefore, appear that we are in possession of a specific chemical reaction by which deficiency of nicotinic acid can be quantitatively measured. This reaction, it may be pointed out, is far more specific than the cyanogen bromide color reaction which has been used by a number of other investigators, since various pyridine derivatives which play no part in pellagra react positively with cyanogen bromide. Our studies on normal persons indicate that only the ingestion of pyridine derivatives with anti-pellagric activity will result in an increase of the fluorescent material described.

We now wish to report a further observation upon the urine of pellagra patients and of dogs with black tongue. Not only is there in pellagra the absence of a urinary component which develops fluorescence on alkalinization, but there appears in the urine of these patients a fluorescent substance which is not normally present, which gives a whitish-blue fluorescence without any alkali addition. Under the conditions used in carrying out our test,[1] this substance appears in the

[1] Najjar and Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[2] For the opportunity to study these cases, we are indebted to the courtesy and cooperation of Dr. Tom D. Spies, of Birmingham, Alabama.

blank. Even in the case of normal urine eluates a positive blank is always obtained—*e.g.*, there is a measurable bluish fluorescence in samples untreated with alkali. This blank is due in part to Rayleigh scattering of the light rays by the solvent itself, and in part to traces of unknown fluorescent compounds. In pellagra, however, the value of the blank is markedly increased, reaching in well-developed cases four or five times the normal values (see Table 1). The substance responsible for the increased fluorescence of the blank has not been identified as yet. Studies of its fluorescent spectrum are in progress. For the present we shall designate it as F_1 and we shall designate the fluorescent substance obtained from normal urine eluates after alkali addition as F_2.

The earliest change in the urine in pellagra appears to be the disappearance of F_2. This occurs before any appreciable increase in F_1 is noticeable (patient "W"). As the disease progresses the increase in F_1 becomes more and more striking. Conversely, it would appear that the first step in the healing of a severe case is some reduction in the excess of F_1, and that subsequent to this F_2 makes its appearance. The effect of treatment with a single dose of nicotinic acid is shown in Table 1. It may be seen that in the most severe case (patient "E") treatment produced only a reduction in F_1 without the appearance of any F_2. In the less severe cases the dose of nicotinic acid employed caused the appearance of F_2.

Our present interpretation of the significance of these two fluorescent compounds in the urine is as follows: an enzyme of which nicotinic acid is a component serves normally to convert the substance F_1 (which is fluorescent regardless of the reaction of the medium) into F_2, a substance which fluoresces in alkaline but not in acid solution. In states of nicotinic acid deficiency this conversion does not take place, and as a result F_1 accumulates. It is worthy of note that in pellagra the total fluorescence (found here altogether in the blank) is often far greater than the maximum fluorescence obtainable by any procedure in the normal subject's urine. The presence of a relatively large amount of fluorescent material in the untreated urinary eluate of the pellagrin suggests that we may be dealing with the material responsible for the photosensitivity of these patients.

We wish to emphasize the fact that the dog with black tongue behaves exactly like the patient with pellagra with respect to the excretion of these fluorescent substances. This is contrary to our earlier impression. At the time of our previous publication we had had the opportunity to study only the urine of a single black tongue dog, before and after treatment. Because of the failure of the dog to excrete F_2 after what we supposed to be adequate treatment we concluded that the dog's metabolism might be different from that of man. It is now clear, however, that the failure of that animal after treatment to exhibit F_2 in his urine was attributable to inadequate treatment; he behaved exactly like the most severe of the pellagra patients, showing only a reduction in an elevated blank as the result of therapy. The adequately treated dog and the normal dog show F_2 in the urine just as in the case of the normal human being, and the concentration of F_2 can likewise be increased in the normal dog by the administration of nicotinic acid.

We have then two criteria by which to characterize states of nicotinic acid deficiency: (1) the disappearance of a normal substance which produces fluorescence on alkalinization, and (2) the appearance of an abnormal substance, which is fluorescent without any such treatment. Both of these substances can be measured quantitatively.

TABLE 1

FLUORESCENCE* OF URINARY ELUATES

Range in normal subjects	Before treatment			After 50 mgms nicotinic acid by mouth		
	Blank†	After alkali	Increase (= substance F_2)	Blank†	After alkali	Increase (= F_2)
	10–15	30–50	20–35	15–20	50–70	35–50
Pellagra: Subject W (very mild)	12	12	0	22	40	18
Subject H (moderately severe)	38	38	0	26	43	17
Subject S (moderately severe)	104	69	0	60	71	11
Subject E (very severe)	64	36	0	40	34	0

* Fluorescence is expressed in Najjar-Wood units, one unit being the fluorescence caused by 1 microgram quinine sulfate dissolved in dilute sulfuric acid.[1] The figures given represent urinary excretion during a 4-hour period preceding and immediately following the administration of a dose of 50 milligrams nicotinic acid by mouth.

† The figure given represents the actual reading of the blank minus a constant correction which has been made for the Rayleigh scattering effect caused by the solvent itself. The fluorescence as given is caused by traces of unknown substances plus that of F_1 when present.

VICTOR A. NAJJAR
L. EMMETT HOLT, JR.
DEPARTMENT OF PEDIATRICS,
THE JOHNS HOPKINS UNIVERSITY

EFFECT OF ALCOHOL ON VITAMIN A CONTENT OF BLOOD IN HUMAN SUBJECTS

IN this laboratory it has been shown in dogs that ingestion of alcohol will increase the amount of vita-

min A contained in their blood.[1] Pett,[2] using his instrument for testing vitamin A deficiency visually in human subjects, has observed unaccountably short recovery times in dark adaption the day following taking of alcohol. This he considers due to an increase in blood vitamin A.

We have made a few preliminary observations on the vitamin A content of the blood in human beings before and after taking alcohol. The Carr-Price colorimetric method, modified by Clausen, was used for these determinations.

The conditions under which the alcohol was taken was the usual "social" evening drinking common in this country. The alcohol was in the form of mixed drinks taken by each subject as desired during the evening.

TABLE I

Subject	Age	Sex	Weight (lbs.)	Amount of alcohol (95%)	Evelyn photoelectric units of vitamin A per 100 Ml of serum*		
					Basal	Four hours after alcohol	Twelve hours after alcohol
A	35	M	170	135 cc	33.8	42.1	42.9
A				145 cc	47.6	50.0	46.6
B	30	M	160	162 cc	93.4	217.7	76.5
C	35	M	160	150 cc	30.5	45.3	41.7
D	31	M	170	126 cc	50.8	54.3	48.3
E	36	F	120	54 cc	40.5	42.2	40.7
F	30	M	240	216 cc	57.0	59.8	48.2
G	29	F	150	261 cc	48.4	60.1	39.5
						Two hours	
H	35	M	160	20 cc	37.8	38.7	
I	33	M	150	20 cc	60.3	62.2	

* One Evelyn Photoelectric unit of vitamin A is approximately equal to three international units of vitamin A.

Blood samples were drawn before the ingestion of alcohol, at the end of the evening (approximately four hours after the first drink) and the following morning (approximately 10 to 12 hours after the ingestion of alcohol).

In every case there was some elevation in the amount of vitamin A in the blood after taking alcohol. Although the increase in most cases was relatively slight, in subject B, whose initial vitamin A content of the blood was extremely high, the rise was also remarkably large. This subject had not been taking any vitamin A concentrates previous to the experiment. The high concentration in the blood suggests that his tissues also contained large amounts of the vitamin.

COMMENT

These findings show that the ingestion of alcohol raises the vitamin A content of the blood of man. We feel that this rise in the blood is probably due to a shift of vitamin A from other tissues of the body, notably the liver, to the blood. Further work will be necessary to determine what factors determine the degree of rise in the blood. Probably the amount of alcohol ingested and the degree of saturation of the body with vitamin A are important factors. Possibly tolerance to alcohol may also be a factor. This effect of alcohol on mobilizing vitamin A from the tissues might form the basis of a test for vitamin A storage in the body.

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[1] S. W. Clausen, *et al.*, SCIENCE, 91: 318.
[2] L. B. Pett, SCIENCE, 92: 63.

ULTRAVIOLET TRANSMISSION BY THE VITELLINE MEMBRANE OF THE HEN'S EGG

THAT the developmental behavior of chick embryos may be altered by exposure to ultraviolet radiation, even when irradiated through the shell or the shell membrane, has been reported by several workers.[1, 2, 3]

It has been shown by Sheard and Higgins[1] and Landauer[2] that the shell may transmit some radiation as short as 2,800–3,000 Å, although perhaps less than one per cent. Absorption by the albumen was not measured by them, although it constitutes an important factor from the absorption view-point.

Hinrichs[3] removed a part of the egg shell and shell membrane and exposed the blastoderm directly to the radiation, which meant that the vitelline membrane (and possibly a very thin layer of albumen) still acted as a filter to the underlying embryo. Although the transmission by the vitelline membrane was not measured, Hinrichs was convinced that it did not effectively shield the embryo from the ultraviolet radiation.

However, in any attempt to correlate quantitatively the effects produced as a function of wave-length with the absorption spectrum of the substance responsible for the behavior in question, it is essential to have numerical data on the ultraviolet transmission by this membrane. It was in connection with an investigation of this kind, to be reported elsewhere by Mr. James O. Davis, that the measurements now reported were undertaken.

An unincubated egg (New Hampshire breed) from the University of Missouri Poultry Farm was opened, and the yolk placed on a watch glass. The vitelline membrane was cut half-way around at the equator

[1] C. Sheard and G. M. Higgins, *Jour. Exp. Zool.*, 57: 205, 1930.
[2] W. Landauer, *Storrs Agric. Exper. Sta. Bull.*, No. 179. 1932.
[3] M. Hinrichs. *Jour. Exp. Zool.*, 47: 309, 1927.

so that the contents of the yolk escaped. The membrane was removed, washed four times in distilled water, and mounted in glycerol between two crystal quartz microscope slides. The preparation was then

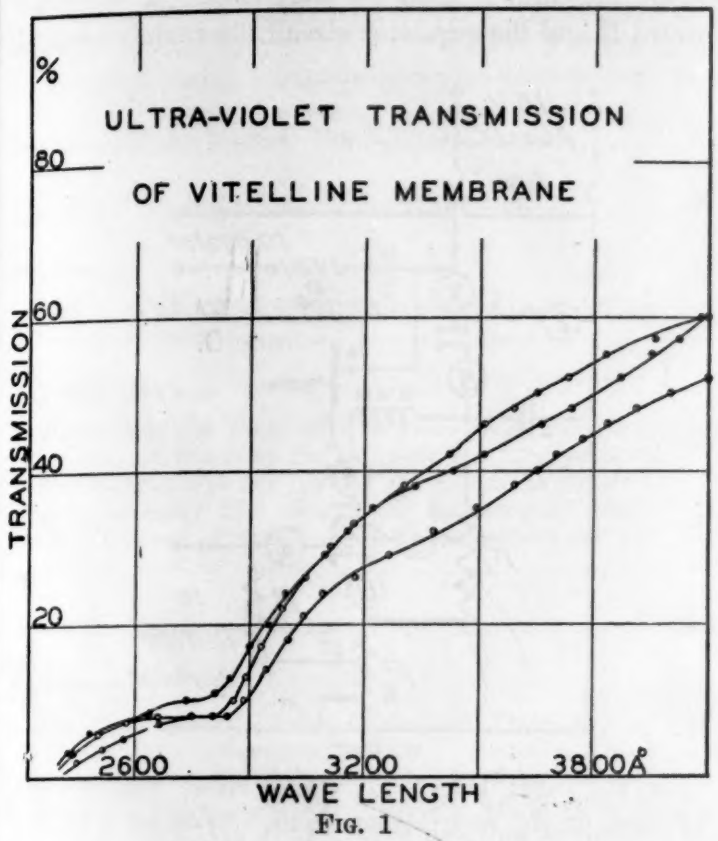

FIG. 1

sealed at the edges with paraffin. Owing to the natural spherical contour of the vitelline membrane, it was not possible to avoid folds entirely when placing it between flat slides; however, the fractional area covered by such folds was estimated to be considerably less than 10 per cent. of the total area of the membrane in the light path.

Transmission measurements were made with a Spekker photometer and a Hilger medium quartz spectrograph. A control consisting of a 10 micron layer of glycerol between another pair of similar crystal quartz slides was employed. The results are shown in Fig. 1, where the per cent. transmission is plotted as a function of the wave-length for each of three separate trials.

It will be noted that selective absorption occurs in the region around 2,800 Å. Since these membranes scatter light noticeably in the visible, it is to be expected that they would do so more strongly in the ultraviolet and that scattering would be responsible in large measure for the low transmission at 4,000 Å. That this is true was demonstrated in an attempt to measure the transmission with a quartz microscope and photocell, in which case the transmission was observed to increase greatly with increased numerical aperture of the objective. To account for the absolute differences in transmission between the three sets of measurements, one must consider natural fluctuations in thickness and possibly variations in membrane composition. It is intended that these results will call attention to the order of magnitude of the transmission; in any given irradiation experiments, it would probably be necessary to make measurements on the particular egg samples employed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE APPARATUS FOR PRESSURE FILTRATION

THE sterilization of protein solutions by Seitz filtration using positive pressure requires a motor, a pump and a tank, all of which are expensive for the small laboratory in which they may be needed at infrequent intervals. Suction produced by water aspiration is slow and noisy and, in addition, since protein solutions foam under reduced pressure, requires "venting" of the system with its possible contamination. We have, in this laboratory, devised a simple, inexpensive instrument suitable for the small laboratory in which there is no compressed-air system.

The tank consists of a single length of six-inch-diameter pipe capped at both ends. One end serves as a base. The other end is pierced by ordinary iron pipe into which is threaded a pressure gauge and two outlets. To one outlet is fixed a tube ending in an automobile tube valve stem. Through this, using a bicycle pump, the tank can be charged. To the other outlet is fixed a piece of fabric-covered pressure tubing ending in an automatic air chuck of the type used on air hoses with which tire tubes are inflated. The pressure cap of the Seitz filter is fitted with a standard valve stem which fits the automatic valve chuck of the tank. The exact details are shown in Fig. 1.

Since the length of fabric-covered tubing may be varied, the tank can be placed in any convenient part of the laboratory. Seitz filters can be set up in groups and several filtrations done at the same time. As filter pads become clogged, the pressure in the tank may be increased so that the rate of filtration is constant. The pressure in the tank can be raised by the pump while filtration is taking place.

Certain details of operation must be given special consideration. Before filters are autoclaved, the pads must be moistened, centered exactly and screwed firmly into place. After sterilization, the screw must be tightened mechanically by pliers. If the pad is loose, or if it is not centered, some fluid may be forced

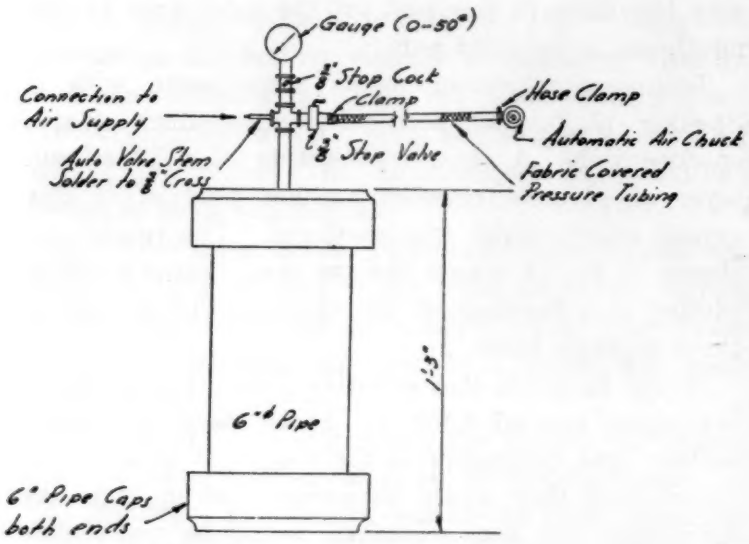

FIG. 1.

around, instead of through, the pad and so escape filtration. While the last charge is passing through the pad, it is best to release the air pressure in the filter chamber before all of the charge has passed through. With this technique, the pad remains moist and, since no air is forced through it, no foam is produced.

By the use of this apparatus, sterilization of protein solutions by Seitz filtration becomes rapid, noiseless, inexpensive and foam-free. The instrument can be made by any competent mechanic.

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AN ELECTRONIC RELAY WITH IMPROVED CHARACTERISTICS

THE electronic relay for heat control, reported by Hall and Heidt in a recent issue of SCIENCE,[1] is substantially identical with a circuit previously described.[2] The circuit was suggested as a variation, suitable for use with DC power lines, of another which applied about half as much voltage across the thermoregulator contacts when both were supplied from the AC mains.

There are now available new tube types which permit some improvement of this circuit, and which require about half as much power for operation. The latter is not negligible, since with continuous operation the power used costs roughly as much per year as the original price of the relay parts. Such a circuit is shown below. When AC operated, the current through the thermoregulator contacts is about one tenth of the peak current with the Hall-Heidt circuit and the maximum potential across the regulator is less than ten volts instead of 35.

[1] A. C. Hall and L. J. Heidt, SCIENCE, 92: 133, 1940.

[2] R. C. Hawes, *Ind. Eng. Chem., Anal. Ed.*, 11: 222, 1939.

The relay is adjusted by placing strap A about two thirds of the way up from the amplifier cathode on resistor R_1 (the adjustment is not critical) and straps B and C at the ground end of R_2. B is then moved toward the cathode until the relay closes. C is moved toward B and the regulator circuit alternately shorted

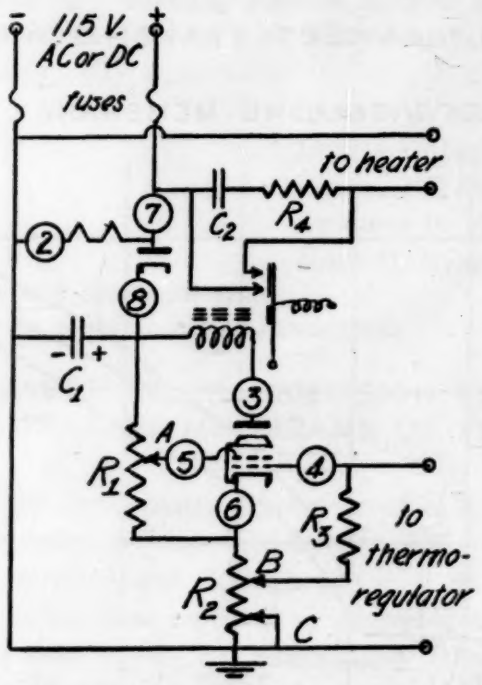

FIG. 1. Tube: 117N7–GT. Octal socket terminals are indicated by the encircled numerals. Terminal 1 has no connection. Relay: DC; 3,000. ohm, 20. milliampere coil (Leach #1201, or equivalent). R_1 4,000. ohms, R_2 1,000. ohms. Both 10. watt, adjustable. An extra strap should be bought for R_2. R_3 1. megohm, ½ watt. R_4 100. ohms, 2 watt. C_1 8. microfarad, 200 v. electrolytic. C_2 0.5 microfarad, 400 v. paper.

and opened until C is as close to B as will permit the relay to open when the control circuit is shorted. Some leeway in these adjustments is advisable to allow for line voltage fluctuations. Care should be taken to connect the relay to the line with the proper polarity if, as is usual, one side of the line is grounded. The circuit may be used with a bimetal thermoregulator by interchanging the leads at B and C.

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